

# PATENT SPECIFICATION

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## DRAWINGS ATTACHED

1259517

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## (54) EARPHONE

(71) We, HOSHIDENKI-SEIZO KABUSHIKI-KAISHA of 4-33, 1-chome, Kitakyuhoji, Yao-shi, Osaka-hu, Japan, a Japanese Company, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to an earphone and more particularly to an earphone which is simple in construction and assembly for ease of mass production.

According to the invention, there is provided an earphone comprising a cylindrical casing having an axial extension of reduced diameter adapted to be inserted into an ear hole, a coil bobbin placed within the casing, a permanent magnet fitted in the bobbin, said magnet being magnetized in the axial direction, said bobbin being formed with a radial flange at its one end adjacent to said axial extension, and a diaphragm positioned on the bobbin by the peripheral part of said radial flange and held in place by the attraction exerted by the magnet.

Preferably, the radial flange at the forward end of the coil bobbin has its forward surface inclined forwardly to leave sufficient air space to allow for the vibration of the diaphragm except its margin where it is securely supported on a flat on the peripheral part of the radial flange. In the preferred embodiment, the bobbin has another radial flange at its rear end and a coil is held in place on the bobbin between the radial flanges. Further, an end member of channel-shaped section is connected to or integrally formed with the rear end of the bobbin and a terminal board extends transversely through the end member. Conveniently such terminal board is held sandwiched between the end plate of the member and one end of the magnet remote from the diaphragm. In this manner, the invention eliminates the necessity of any screwing or crimping operation in assembly.

For the better understanding of the invention an embodiment thereof will be described with reference to the drawings, in which

Figure 1 is a longitudinal section of the earphone constructed in accordance with one embodiment of the invention, 50

Figure 1a is a fragmentary view of part of Figure 1, and

Figure 2 is a rear view of the bobbin shown in Figure 1. 55

Referring to the drawings, there is shown a casing 1 which comprises a hollow cylindrical body 1a and an axial extension, 1b, of reduced diameter which is integral and aligned with the body 1a. The axial extension 1b is adapted to be inserted into an ear hole and has an opening 2 formed in its forward end wall for allowing transmission of sound there-through which is produced by the vibration of the diaphragm of the earphone. The body 1a is closed by a detachable rear lid 1c. The cylindrical part of the rear lid is formed with an axially extending projection 1d of reduced thickness, the projection having an annular rib 3 on its outer periphery. In the inner surface of the body 1a is formed an annular groove 4 which is engaged by the rim 3. The parts 1a, 1b and 1c of the casing can be moulded from synthetic resin material such as polyethylene. 75

Centrally within and concentrically with the casing body 1a is placed a coil bobbin 5 which has an integral radial flange 6 at its forward end, that is, at the end adjacent to the axial extension 1b. As shown, the radial flange 6 is inclined forward to approach a part 1a' which joins the body 1a with the extension 1b. The flange 6 may be formed with a gradually increasing thickness so that its forward surface becomes inclined forwardly. Alternatively, the flange 6 may be perpendicular to the axis of the bobbin and have an axially extending part at its outer periphery. The radial dimension of the flange 6 is slightly less than the inside diameter of the body 1a. A diaphragm 7 is engaged and positioned by the peripheral part of the radial flange 6 and is held in place by the attraction exerted by a permanent magnet 8 which fits in the bobbin 5 and is magnetized in the axial direction thereof. For this purpose, the outer 95

end of the radial flange 6 is formed with an annular flat 9 (Figure 1a) which lies in a plane perpendicular to the axis of the casing body. An annular rim 10 extends axially from the outer periphery of the flat 9. The arrangement is such that the edge of the diaphragm 7 engages the rim 10 and is urged against the flat 9 under the action of the magnet 8, with a given pressure. The bobbin 5 is provided with another radial flange 5a at its rear end and a coil 11 is wound on the bobbin intermediate the radial flanges 6, 5a.

Integrally formed with or connected with the bobbin 5 is a projecting end member 12 of channel-shaped section which extends rearwardly behind the radial flange 5a. The end member 12 has an axial length such that an air gap is left between the inner end of the magnet 8 and the end plate of the member, and in the axially extending part of the member 12 are formed two apertures forming with the air gap a slot through which extends a terminal board 13, formed for example from Bakelite (R.T.M.).

As shown in Figure 2, a pair of conductive pieces 17a, 17b are provided, for example by printing, on the opposite ends of the terminal board 13 to serve as a junction point between the coil 11 and lead wires 16, the ends of the coil being let through a notch 18 formed in the radial flange 5a and the lead wires extending to the outside of the casing 1 through a hole 20 therein. The connection can be achieved by soldering. The bobbin 5 and its radial flanges 5a, 6 as well as the end member 12 are preferably formed integrally by moulding from suitable flexible synthetic resin material such as polyethylene so that when the magnet 8 is fitted into the bobbin 5, the magnet is held in place by the resilience of the bobbin material and the terminal board 13 is similarly held in place between the end plate of the end member 12 and the rear face of the radial flange 5a or the inner end of the magnet 8. If required, adhesive may be applied to secure the magnet and the terminal board.

In order to support the bobbin assembly in the casing in a stable manner, a buffer element 15 which may comprise sponge, rubber, polyurethane or the like can be filled in the space between the bobbin assembly and the rear lid 1c, thereby resiliently urging the assembly against the radially extending part 1a' of the body 1a. Preferably the part 1a' is provided with an annular rib 14 on its inner wall for engagement with the periphery of the diaphragm 7 when the bobbin assembly is so urged.

It will thus be seen that the number of parts required is minimized, and while the earphone is a miniature device, no screwing or crimping operation is required. The ear-

phone is simple in construction and assembly and therefore inexpensive. It will be appreciated that such simplicity of construction is enabled by eliminating a magnetic yoke which is usually provided to complete the magnetic circuit through the permanent magnet. It is found, however, that the earphone operates satisfactorily for all practical purposes without the yoke.

#### WHAT WE CLAIM IS:—

1. An earphone comprising a cylindrical casing having an axial extension of reduced diameter which is adapted to be inserted into an ear hole, a coil bobbin placed within the casing, a permanent magnet fitted in the bobbin, said magnet being magnetized in the axial direction, said bobbin being formed with a radial flange at its one end adjacent to said axial extension, and a diaphragm positioned on the bobbin by the peripheral part of said radial flange and held in place by the attraction exerted by the magnet.
2. An earphone according to Claim 1, wherein the peripheral part of the radial flange is formed at its forward end with an annular flat which lies in a plane perpendicular to the axis of the bobbin and with an annular rim extending from the outer periphery of the flat, the peripheral edge of the diaphragm being positioned by the annular rim and urged against the flat by the attraction of the magnet.
3. An earphone according to any one of Claims 1 and 2, wherein the casing is inwardly provided with an annular rib, against which the peripheral edge of the diaphragm abuts.
4. An earphone according to any one of Claims 1, 2 and 3, wherein the bobbin is formed with a projecting end member shaped to provide a slot between it and the end of the bobbin, a terminal board extending through the slot, the ends of a coil wound on the bobbin being secured to opposite ends of the terminal board which project out of the end member.
5. An earphone according to any one of Claims 1, 2, 3 or 4, wherein a buffer element is placed between the end of the bobbin remote from its radial flange and one end the casing, so locating the bobbin in the casing.
6. An earphone substantially as herein described with reference to and as illustrated in the accompanying drawings.

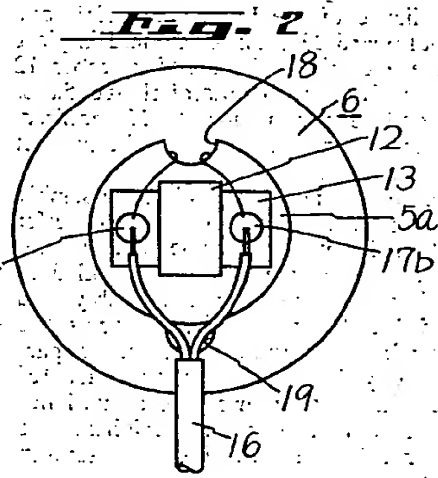
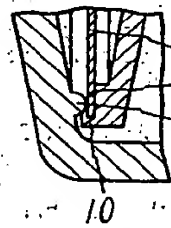
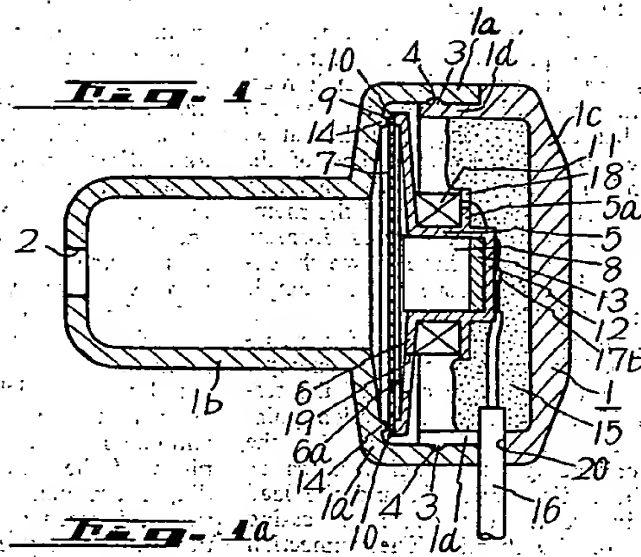
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COMPLETE SPECIFICATION

1 SHEET

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